DSMS (Deep Space Mission System) Investment in support of Satellite Constellations and Formation Flying

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Abstract

Over the years, NASA has supported unmanned space missions through a Deep Space Mission System (DSMS) that is developed and operated by the Jet Propulsion Laboratory (JPL) and its subcontractors. The DSMS capabilities have been incrementally upgraded since its establishment in the late '50s and are delivered from three Deep Space Communications Complexes (DSCC's) near Goldstone, California, Madrid, Spain, and Canberra, Australia and from facilities at JPL. Traditionally, mission support was assigned on an individual-mission basis - tracking, command, telemetry and so forth, between each mission and a ground-based network, independent of other missions. As NASA, and its international partners, are moving toward flying full constellations and precision formations, the DSMS is developing plans and technologies to provide the requisite support. The key activities under way are:

(1) Communications infrastructure around Mars, including lower-orbit and "stationary" satellites, to provide continuous coverage for orbiters, landers and rovers. JPL is developing an architecture, as well as protocols and equipment required to operate such infrastructure in a cost-effective way.

(2) Internet-type protocols that will allow for efficient operations across the deep-space distances, accounting and accommodating the long round-trip-light-time. JPL is working with the CCSDS to convert these protocol to an international standard.

(3) Techniques to perform cross-navigation between spacecraft that fly in a loose formation. Typical cases are cross-navigation between missions that approach Mars and missions that are at Mars, or the determination of a baseline for missions that fly in a earth-lead-lag configuration.

(4) Techniques and devices that allow the precise metrology and controllability of tight formations for missions such as ST-3 and ST-5.

In this paper we discuss the four classes of constellation/formation support with emphasis of DSMS current status (technology and implementation) and plans in each area.

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